AYUSHDHARA
ISSN: 2393-9583 (P)/ 2393-9591 (O)
An International Journal of Research in AYUSH and Allied Systems

Research Article

A COMPARATIVE PHARMACEUTICAL STUDY OF *MANDURA BHASMA* (IRON OXIDE-BASED POWDER MEDICINE) PREPARED BY TWO DIFFERENT METHODS

Kumar Pankaj[1]*, Dwivedi Prabhat Kumar[2]
*[1]PG Scholar, [2]Professor, Department of Rasa shastra and Bhaishajya Kalpana, Govt. Ayurvedic College, Patna, Bihar, India.

Article info
Article History:
Received: 12-03-2025
Accepted: 11-04-2025
Published: 20-05-2025
KEYWORDS:
Ayurveda, *Bhasma, Mandura, Shodhana, Bhavana, Marana.*

ABSTRACT

In Ayurveda, drugs are basically derived from plant, animal, and mineral origins. Rasa shastra is unique branch of Ayurveda which mainly deals with drugs having metals and mineral origin. Apart from herbal medicines, metal and mineral-based drugs have gained popularity due to their rapid action in very low doses and their long shelf life. However, the primary challenge is to convert metals and minerals origin drugs into absorbable and assimilable forms. so, that the drugs not produce any ill effect over body system. In order to overcome this problem raw metals and minerals are changed into an organo-metallic assimilable form known as *Bhasma*. The process by which metals and minerals drugs converted into herbo-minerals forms called *Bhasmikarana. Mandura* is an important iron oxide-based drug used for management of various ailments as described in various Ayurvedic texts. The preparation of *Mandura Bhasma* involves three main processes, namely *Shodhana* (purification) process, *Bhavana* (trituration), *Marana* (incineration) process. There are lots of process described in Ayurvedic text but little research work was done to know the methods that are highly valuable. Now current needs are to adopt such methods for drugs preparation which is cheap, safe, efficient that can be easily available to the common peoples. In current study two methods were employed for the preparation of *Mandura Bhasma* and analytical study was performed to compare the best methods among them with reference to quality, efficacy and safety.

INTRODUCTION

Mandura, commonly referred to as iron slag, is a compound of metallic oxide and silicate of iron, typically represented by the formula $FeSiO_4$. It is known by various names, such as *Kitta*, *Lohabhava*, *Lohamla*, and *Lohakitta*.[1] In India iron ore is mined from Jharkhand, Orissa, Goa, Maharashtra, Andhra Pradesh, Kerala, Rajasthan and Tamil Nadu. Properly incinerated *(Samyag Marita) Mandura bhasma* possesses various characteristics features such as *Sita virya* (cooling potency), *Sita guna* (cooling properties), and is enriched with *Madhura rasa* (sweet taste). It is known for its *Vrishya* (aphrodisiac) and *Ruchikaraka* (appetizer) properties. It is highly effective as a *Pitta Shamaka* (pacifier of *Pitta dosha*), *Rakta vriddhikara* (blood-enricher), and is beneficial in managing conditions like *Pandu* (anemia) and *Kamala* (jaundice).[2]

Indian government work continuously for uplifting of Ayurvedic sectors and to establish it on global platform. Therefore, various research works has been done to validate ayurveda as an evidence-based medicine. The primary aim of the *Bhasma* preparation is to remove impurities and reduce particle size, facilitating better absorption in the gastrointestinal tract and improving its bioavailability. It is very interesting that each metal and minerals drugs having specific media for *Sodhana* (purification) and trituration process. This media *(Bhavana Dravya)* and number of incineration cycle directly affect the physio-chemical properties of drugs through transformation of non-assimilable minerals drugs into assimilable herbo-minerals forms. The present work focused on

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Quick Response Code
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preparation of *Mandura Bhasma* through two different methods by using two different triturating media and incineration *(Maran)* cycle.

MATERIALS AND METHODS

Materials

The raw materials and equipment's for *Mandura bhasma* preparation was collected from Rasa shastra department, Government Ayurvedic College, Patna, Bihar. Identification of raw drugs was done by specialist concerned person of Rasa shastra department of our college.

Methods

Raw *Mandura* was collected and subjected for purification process (figure 1). Morning cow urine was collected and as per need urine was poured in stainless steel container *(Bhagona)* (figure 2. *Mandura* (impure) having weight of 5kg and 500gm was first made into coarse powder by using *Udukhala yantra* (mortar and pestle) then subjected to *Sodhana* process (purification) by *Nirvapa* method (figure 3, 4). In this *Nirvapa* method powder *Mandura* was taken in iron pan and was heated on gas stoves up to red-hot stage and then process of quenching was done by dipping red-hot *Mandura* in cow urine after self-cooling the sample was collected and repeated the process for 7 times and in every time fresh cow urine was taken, approximately 38 litres of cow urine was used in entire 7 cycles (Table 1).[3]

Table 1: Purification of Raw *Mandura*

Wt. of *Mandura* before *Sodhana*	Total amount of urine taken for 7 times *Nirvapa* process	Wt. of *Mandura* after *Sodhana*	% weight loss
5400 gm	42 liters	4790 gm	11.29

Cause of weight loss: It may due to removable of impurities present in *Mandura* as well as during quenching process some of the *Mandura* in powder get loss along with vapours.

After proper drying, *Sodhit mandura* was collected and equally divided into two parts (figure 5,6). The aloe vera leaves were rinsed with tap water, and the thorny edges and tips were trimmed off using a knife. The mucilaginous pulp was carefully extracted from the leaves, blended in a mixer, strained, and utilized in the trituration process for the preparation of *Mandura Bhasma* batch 1 (Table), (Figure 7).

Table 2: Preparation of *Aloe Vera* juice *(Kumari swarasa)*

Weight of Aloe-vera leaves *(Kumari)*	Colours	Taste	Total *Swarasa* obtained	Percent yields
40.5 kg	Watery	Bitter	29.565 L	73% approx.

The purified *Mandura* of first part was levigated with *Aloe Vera* juice *(Kumari patra swarasa)* continuously until the *Bhavita dravya* becomes soft in nature (Figure 8).[4] So, that the pellets can be made easily without any cracks on periphery.[5] Then pellets of 2.5cm diameter and thickness 0.5cm was made and kept on butter paper for drying in sunlight (figure 9). After proper drying of *Chakrika* it was placed in earthen pot *(Sarava)* which was closed by same size of earthen pot and gap was filled with clay and junction was sealed with two folded clay smeared cloth then allowed for complete drying (figure 10, 11). After drying of *Sarava Samputa*, it was subjected for *Marana* process (incineration process) in Electric Muffle Furnace (EMF) which is set at maximum temperature of 650°C (figure 12). After reaching 650°C degree the furnace is further set for an hour at constant 650°C temperature after the end of heating, furnace was power off and keep it for self-cooling.[6] The material was collected by opening Earthen pot by using knife and grounded to powder form by using mortar and pestle (figure 13). This same process was repeated 7 times and finally reddish coloured *Mandura Bhasma* (Batch 1) was obtained (figure 14).

In similar way the remaining part of purified *Mandura* sample was taken and levigated with *Triphala kwatha*.[7] *Triphala Kwatha* was made by taking seedless *Yavkuta Amalaki, Vibhitaki* and *Haritaki* in equal proportion poured into stainless steel vessels and then water was taken in stainless steel vessels 8 times then *Bhavita dravyasa.* The whole mixture was boiled in mild fire till the liquid parts was reduced to 1/8th (figure 15) (Table3).[8] This *Kwatha* was used for trituration process (figure 16). Trituration was carried out continuously for six hours in each cycle of *Mandura Bhasma* preparation. After proper trituration, pellets were made in 2.5cm diameter and 0.5 cm thickness then after proper drying of pellets *Sarava samputikarana* was done and left for drying of *Sarava* (figure 17, 18, 19). The *Sarava samputa* was subjected for *Marana* process at same temperature and time period as used in preparation of batch 1 *Mandura Bhasma* (figure 20). The process was repeated 30 times, finally after grinding of 30th incinerated *Mandura* pellets, red colored *Mandura Bhasma* (Batch 2) was obtained (figure 21, 22). Precautionary measure was taken throughout the process for minimum loss and maximum yields.

Table 3: Total amount of *Triphala Kwatha* obtained during 30 times Trituration of *Mandura* for *Marana* process

Total weight of *Yavakut Triphala*	Total Amount of water used	*Triphala Kwatha* Obtained
72kg	576 litres	39 litres

Purification process of *Mandura Bhasma*

Fig. 1: Raw *Mandura*

Fig.2: Cow Urine

Fig.3: Heating of *Mandura* at Red hot stage

Fig.4: *Nirvapa* process

Fig.5: Drying of *Shodhita Mandura*

Fig.6: *Sodhita Mandura*

Preparation of *Mandura Bhasma* (Batch 1) *Bhavita* with *Kumari swarasa*

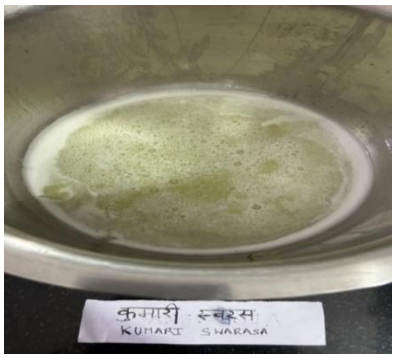

Fig.7: *Kumari Swarasa*

Fig.8: Levigation with *Kumari swarasa*

Fig.9: *Chakrika Nirmana* (Batch 1)

Fig.10: Dried pellets of MB (Batch1)

Fig.11: *Sharava Samputikarana*

Fig.12: Incineration in EMF

Fig.13: Trituration of incinerated MB batch 1

Fig.14: *Mandura Bhasma* (Batch 1)

Preparation of MB Batch 2 with media *Triphala Kwatha*

Fig.15: *Triphala Kwatha*

Fig.16: Levigation with *Triphal kwatha*

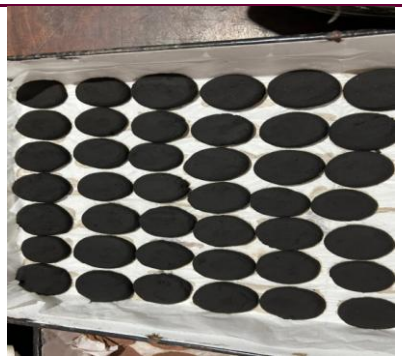

Fig.17: *Chakrika* (Batch 2) **Fig.18: Dried pellets of MB (Batch 2)**

Incineration process (*Marana* process) and Finished product- *Mandura Bhasma* (Batch 2), *Bhavita* with *Triphala Kwatha*

Fig.19: *Sarava samputikarana* (Batch 2) **Fig.20: Incineration in EMF**

Fig.21: Dry Trituration of MB batch 1 **Fig.22: *Mandura Bhasma* (Batch 2)**

OBSERVATION AND RESULTS

During the *Sodhana* (purification) process, *Mandura* was strongly heated until it became red-hot. This process produced a crepitation sound due to the evaporation of water present in the sample. By the end of the *Sodhana* process, the colour of *Mandura* changed from light black to dark black, with a noticeable increase in brittleness. The particle size reduced, while the weight increased, due to the deposition of constituents from urine within the vacant spaces of the *Mandura* with each trituration step, the trituration process became progressively smoother and easier. The *Mandura* sample triturated with aloe vera *Swarasa*, the colour of the *Mandura* changed from dark blackish to reddish-brown while *Mandura* sample triturating with *Triphala kwatha*, the colour shifted from blackish to dark black.

Initially, the outer surface of the pellets was rough, less brittle, and harder to break. However, with each successive puta (heating cycle), the pellets became smoother, more brittle, and more fragile, making them easier to break. The metallic shine also diminished in both samples of MB Batch 1 and MB Batch 2.

By the fifth *Puta*, the pellets of Batch 1 uniformly turned a reddish-brown colour. In contrast, even after the tenth puta, the pellets of Batch 2 remained brown on the outer surface but was completely black inside.

After the initial heating cycle, the *Mandura bhasma* from Batch 1 appeared gray, whereas the Batch 2 sample was dark black. With each subsequent *Marana* process (heating cycle), both samples developed a slightly gritty texture. Over time, the colour of the *Bhasma* darkened, indicating progress in

the transformation process, and its texture became finer and more powder.

Upon completing the *Marana* process, the *Mandura bhasma* of Batch 1 exhibited a reddish-brown colour, while the Batch 2 *Bhasma* had a reddish hue resembling *Rakta chandana*. The final product in both cases was characterized by very fine, uniform particle size, light weight, a soft texture, and a lack of metallic shine. The specific observation after each incineration cycle for the preparation of MB batch 1 was detailed given in table 4 and changes in weight was given in table 5. The total loss in preparation of MB batch 1 medicine was 13.86% while the total loss in the preparation of MB batch 2 was 21.63%. The detailed observation and changes in weight during each incineration cycle for the preparation of MB batch 2 was given in table 6 and 7 respectively.

Table 4: Specific observation of *Mandura Bhasma* after Each *Puta* (Batch 1)

No. of *Puta*	Colour of *Mandura Bhasma*	*Chakrika* Consistency	*Chandrika*	Highest Temperature (centigrade)	Date of *Puta*
1.	Greyish brown	Very hard	+++	650°C	06/05/2024
2.	Greyish brown	Very hard	+++	660°C	14/05/2024
3.	Greyish brown	Hard	++	658°C	18/05/2024
4.	Redish brown	Hard	+	690°C	25/05/2024
5.	Redish brown	Soft	+	652°C	29/05/2024
6.	Redish brown	Soft	-	650°C	03/06/2024
7.	Redish brown	Soft	-	656°C	13/06/2024

Table 5: Weight of *Mandura Bhasma* after each *Puta* (MB batch1)

No. of *Puta*	*Sodhita Mandura* (gram)	*Kumari Swarasa* (ml)	No. of *Sharava* used (diameter-17cm)	Procured material (gm)
1.	2395	960	4	2340
2.	2340	936	4	2289
3.	2289	915	4	2241
4.	2241	896	4	2196
5.	2196	878	4	2148
6.	2148	860	4	2109
7.	2109	843	4	2063

Table 6: Specific observation of *Mandura Bhasma* batch 2 *(Triphala kwatha Bhavita)* after Each *Puta*

No. of *Puta*	Color of *Mandura Bhasma*	*Chakrika* Consistency	*Chandrika*	Highest Temperature (centigrade)	Date of *Puta*
1.	Dark blackish	Very hard	++	680°C	03/05/2024
2.	Dark blackish	Very hard	++	660°C	07/05/2024
3.	Dark blackish	Very hard	++	658°C	10/05/2024
4.	Dark blackish	Very hard	++	674°C	14/05/2024
5.	Dark blackish	Very hard	++	654°C	21/05/2024
6.	Dark blackish	Hard	++	650°C	25/05/2024
7.	Dark blackish	Hard	+	666°C	29/05/2024
8	Dark blackish	Hard	+	650°C	03/06/2024
9	Blackish brown	Hard	+	650°C	07/06/2024
10	Blackish brown	Hard	+	655°C	11/06/2024
11	Blackish brown	Hard	+	680°C	15/06/2024

12	Blackish brown	Hard	+	658°C	20/06/2024
13	Blackish brown	Soft	-	662°C	25/06/2024
14	Brownish	Soft	-	671°C	28/06/2024
15	Brownish	Soft	-	657°C	02/07/2024
16	Brownish	Soft	-	650°C	05/07/2024
17	Brownish	Soft	-	680°C	09/07/2024
18	Reddish brown	Soft	-	651°C	12/07/2024
19	Reddish brown	Soft	-	655°C	16/07/2024
20	Reddish brown	Very soft	-	678°C	20/07/2024
21	Reddish brown	Very soft	-	666°C	25/07/2024
22	Reddish brown	Very soft	-	652°C	29/07/2024
23	Reddish brown	Very soft	-	680°C	02/08/2024
24	Brick red	Very soft	-	656°C	06/08/2024
25	Brick red	Very soft	-	672°C	09/08/2024
26	Brick red	Very soft	-	660°C	14/08/2024
27	Brick red	Very soft	-	652°C	19/08/2024
28	Brick red (*Rakta Chandan* color)	Very soft	-	667°C	23/08/2024
29	Brick red (*Rakta Chandan* color)	Very soft	-	671°C	29/08/2024
30	Brick red (*Rakta Chandan* color)	Very soft	-	662°C	03/09/2024

Table 7: Weight of *Mandura Bhasma* (MB batch 2) after each *Puta*

No. of *Puta*	*Sodhita Mandura* (gm)	Wt. of *Bhavana Dravya (Triphala Kwatha)*	No. of *Sharava* used (diameter-21cm)	Procured material (gm)
1	2390	750ml	4	2345
2	2345	710 ml	4	2323
3	2323	690ml	4	2304
4	2304	656ml	4	2283
5	2283	640ml	4	2266
6	2266	636ml	4	2251
7	2251	620ml	4	2232
8	2232	604ml	4	2216
9	2216	596ml	4	2202
10	2202	586ml	4	2185
11	2185	562ml	4	2175
12	2175	558ml	4	2162
13	2162	542ml	4	2147
14	2147	532ml	4	2136
15	2136	524ml	4	2123
16	2123	520ml	4	2110
17	2110	512ml	4	2102

18	2102	502ml	4	2094
19	2094	490ml	4	2082
20	2082	472ml	4	2073
21	2073	449ml	4	2062
22	2062	428ml	4	2055
23	2055	412ml	4	2042
24	2042	392ml	4	2016
25	2016	380ml	4	1992
26	1992	376ml	4	1968
27	1968	370ml	4	1943
28	1943	365ml	4	1921
29	1921	362ml	4	1896
30	1896	356ml	4	1873

DISCUSSION

Mandura is a significant mineral-based medicine with numerous health benefits. However, it can only be utilized for therapeutic purposes when it is properly processed according to the methods outlined in different classical Ayurvedic pharmaceutics texts. Purification of raw *Mandura* was done by heating of *Mandura* at red-hot stage followed by quenching (*Nirvapa* process) in cow urine. The purification process completed after 7 cycles. This purification process (heating and quenching) directly affects the physical and chemical nature of *Mandura* (iron- oxide). Firstly, continuous heating and cooling of *Mandura* weaken inter molecular bond of iron oxide. Thus, brittleness increases while hardness decreases. Secondly cow urine helps in removing impurities like dirt, dust and hazardous elements due to making complexes with it which is due to acidic and highly polar nature of urine.[9] The total loss in weight of *Mandura* after purification process is 11.29% which may due to removal of impurities.

In *Marana* (incineration) process, *Mandura Bhasma* batch 1 was prepared using aloe-vera juice *(Swarasa)* as a media for levigating process and 7 incineration cycles while *Mandura Bhasma* (batch 2) was prepared using *Triphala Kwatha* in trituration process and 30 incineration cycles. The incineration process was done using electric muffle furnace at average temperature of 650°C and the average time taken by electric muffle furnace to reach the temperature of 650°C was 2 hours and 30 minutes maximum temperature. After reaching EMF at maximum temperature, the constant temperature was maintained for an hour, proper monitoring of temperature was done by using high temperature bearing thermocouple enable digital thermometer. The increasing annealing temperature of a sample cause increase in average size of an individual crystal and lattice strain.[10] This leads to change in structural parameters of the sample. Analytical test was required to know the such changes. The net yield of finished product using first process is 88.71% by weight while second is 86.14% (table 8, 9). Both batches of medicine have successfully passed ancient and modern analytical tests which justified the ideal nature of *Bhasma*.

Table 8: Statistics of product, *Mandura Bhasma* Batch 1

Wt. of *Mandura* before *Bhavana*	Wt. of *Bhavana Dravya*	Final wt. of *Mandura Bhasma*	% change in wt. of *Mandura Bhasma*
2395gm	Q.S. (6288ml)	2063gm	↓ 13.86%

Reason of loss: Due to scattering of some samples during each and every levigation process and some particles are loss due to sticking with butter paper during drying process.

Table 9: Statistics of product, *Mandura Bhasma* Batch 2

Wt. of *Mandura* before *Bhavana*	Wt. of *Bhavana Dravya (Triphala Kwatha)*	Final wt. of *Mandura Bhasma*	% change in wt. of *Mandura Bhasma*
2390gm	Q.S. (15592ml)	1873gm	↓ 21.63%

Reason of loss: Loss may be due combustion of organic matters, as *Mandura* is a hydrated ferric oxide and on high temperature it loses its water of hydration so in this process some weight is also loss and some due to mishandling.

CONCLUSION

The present study validates that the process explained in classical text, Rasamrita (3/149) and Rasa Tarangani (20/129-130) can be successfully employed for the preparation of *Mandura Bhasma*. However, pharmaceutically the process explained in *Rasamrita* was more economic, convenient, and less time consumables as compared to the process explained in text *Rasa Tarangani*. Both batch of medicine ideally passed the classical and modern *Bhasma pariksha* (analytical test) which indicates that raw *Mandura* totally convert into herbo-mineral assimilable forms. The present study helps in developing cost-effective treatments for the benefit of humanity, as well as establishing standardized methods for both drug preparation and analysis, ensuring the production of high-quality medicines on a global scale. Further clinical trials are necessary to assess the efficacy of medicine of MB batch 1 and batch 2. There is also need of further work to standardize the pharmaceutical process and also to know the pharmacokinetics and pharmacodynamics of *Mandura Bhasma*.

Acknowledgment

I acknowledge my present study to the faculty members of the Rasa Shastra department, Government Ayurvedic College, Patna, Bihar, and to my wife and little daughters.

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Cite this article as:
Kumar Pankaj, Dwivedi Prabhat Kumar. A Comparative Pharmaceutical Study of Mandura Bhasma (Iron Oxide-Based Powder Medicine) Prepared by Two Different Methods. AYUSHDHARA, 2025;12(2):86-94.
https://doi.org/10.47070/ayushdhara.v12i2.1993
Source of support: Nil, Conflict of interest: None Declared

***Address for correspondence**
Dr. Kumar Pankaj
PG Scholar,
Rasa shastra and Bhaishajya Kalpana Department,
Govt. Ayurvedic College, Patna, Bihar.
Email: p121ankajkumar@gmail.com

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